AVIATION

AND

AERONAUTICAL ENGINEERING

Photo by Paul Thompson

General Joffre Inspecting a Captured German Aeroplane

SEPTEMBER
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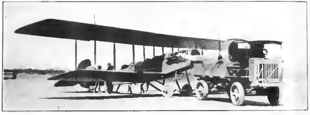
The First Aero Squadron U. S. A. on the Border

Part of the First Aero Squadron. The Entire Squadron Is Now Completely Equipped with All the Machine Guns, Bomb Cameras and Motor Trucks Called for in the Army Specifications



One of the New 160 Horse-power Aeroplanes Towed by a Jeffery Truck Near Its Base at Columbus, New Mexico. Tent and Machine-shop Trucks Are an Essential Part of the Equipment

Two of the Powerful Tractor Biplanes That Have Supplanted the Puny Schooling Machines First Sent to the Border. Since This Photograph Was Taken These New Machines Have All Been Equipped with Mounted Lewis Machine Guns

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Vol. 1 September 15, 1916 No. 4

THE leading article on the next page of this issue, "Military Aeroplanes," is, we believe, the most important announcement that the War Department has ever issued in regard to aeronautics in the United States Army. The officer in charge of the Aviation Section of the Signal Corps, U. S. A., says of it in a letter addressed to AVIATION AND AERONAUTICAL ENGINEERING: "It is intended to create discussion," and the article itself has this to say:

> "The purpose of this memorandum is to initiate a discussion . . . ."

We have no doubt that it will raise discussion in every quarter where men are to be found who take an interest in army aeronautics. Many constructors will be startled by the first announcement of the memorandum:

> "It is submitted that the type of aeroplane which all constructors have attempted to build in this country, the so-called 2-place reconnaissance tractor biplane with one motor, is a false development."

While this statement is bound to shock many American constructors, there can be no question that the army officers who are responsible for it have based their conclusion upon an intimate knowledge of European successes and failures.

The great stimulus which this memorandum will give to the building of fast single place machines and large twin motored tractors is evident from a cursory perusal. The specifications which call for a speed of 115 miles an hour from a rotary motored one place tractor, together with a climb of 8,000 feet in ten minutes, are severe in the extreme, yet the value of such a type of machine in operations against an enemy equipped with a real aerial arm cannot be overestimated.

Americans are fairly conversant with the work of the American Escadrille connected with the French Army. The work of such men as Lieut. William Thaw, Bert Hall, Eliot Cowdin and Norman Prince, has shown that Americans are at least the equal of any other pilots in the handling of speedy scout machines. The Army specifications for a "pursuit" machine of great speed and with unusual climbing ability will, if deliveries are made in any reasonable period of time, give to the American Army a machine which the resourcefulness and independence of the American character can utilize to the best advantage.

The large sized twin-motored machine which, according to the memorandum, will comprise 28 per cent of all the machines which we shall have to have in case of war, and which can be used as a combat machine, a bomber for extreme long-range reconnaissance and for hydro work, entails many difficulties of construction. The gyroscopic effect of twin-engines, in putting additional strain on the compression members of the landing chassis when bringing a machine of this type to earth, is but a single one of the subjects which will demand careful study.

The pleasure which AVIATION AND AERONAUTICAL ENGINEERING takes in submitting this memorandum to its readers cannot be exaggerated. Backed by an appropriation of $13,281,666, Lieut.-Colonel George O. Squier and his associates have set about building up an air-service for the army with businesslike expliciteness and despatch. All the lessons which our military authorities learned from the European war have been carefully digested, so that almost upon the heels of the signing of the appropriation bill we find the Aviation Section of the Signal Corps ready to give detailed information about its intentions and aspirations.

The general adoption of Dep control for all aeroplanes in our Army, Navy and National Guard, announced in our last issue, gave the first indication of the very real desire which the War Department is exhibiting to assist American constructors through standardization. The memorandum which is published in this issue goes much further. Its effect in standardizing American military aeronautics will be an unalloyed benefit to the industry. And yet the fact that in giving this article for publication the War Department announces that "the purpose is to initiate discussion" proves that those in control still have open minds for future developments.

In view of this desire on the part of the War Department to obtain expressions of opinion, AVIATION AND AERONAUTICAL ENGINEERING will be glad to open its columns to all constructors of aeroplanes and aeroplane motors who care to use them to discuss the War Department's memorandum. Designers of aeroplanes and aeronautical motors are urged to send AVIATION AND AERONAUTICAL ENGINEERING their opinions and criticisms. Open discussion of all technical articles appearing in any issue will always be welcomed. The more points of view that can be secured, the more valuable will each issue be to the aeronautical industry.

Every manufacturer of aeroplanes and aeroplane motors should be grateful to the War Department for its promptness in making this announcement. Everyone interested in the industry will await eagerly the publication of the detailed specifications for the six types of aeroplanes and four types of aeroplane motors, which the memorandum states, the Army will need.

MILITARY AEROPLANES

Memorandum on the Future Developments of Military Aeroplanes for the Army Air Service and Proper Motive Units Therefor

Prepared in the Office of the Officer in Charge of the Aviation Section, Signal Corps, U. S. A.

At a meeting of the Aeronautical Motor Division of the Society of Automobile Engineers, July 18, 1916, attended by representatives of manufacturing companies interested in aeroplane motors, and by representatives of our Army and our Navy, one of the most important topics advanced for discussion was that of the probable future demand for motors of various powers. Quite naturally, the producing industry must learn at the earliest possible moment whether future military service will require more 200 h.p. units than those of 100, etc., or in other words, JUST WHAT WILL BE THE PROBABLE DEMAND FOR THE VARIOUS SIZES.

The purpose of this memorandum is to initiate a discussion which may help to solve this problem, as far as the Army air service is concerned. Of course, it is impossible, at this date, when the science of aviation is only seven years old, to predict, with any degree of accuracy, what the development in the design of military aeroplanes will be a few months hence. However, we must help the motor builders by giving them all the information at our disposal upon which to base their efforts.

This office has attempted to attack the problem by analyzing the types of aeroplanes which will develop as the result of required military functions, which demand certain military loads, radii of action and speeds.

It is submitted that the type which all constructors have attempted to build in this country, the so-called 2-place reconnaissance tractor biplane, with one motor, is a false development. Its reason for being appears to be a natural growth from the tractor training machine. It has been much simpler and easier to design by increasing the scale than to design a new.

While this may always be a useful type for long-range reconnaissance when operating against an enemy who has no aeroplanes, it appears that, if we encounter an enemy equipped with aeroplanes, its value will be dwarfed in comparison with that of the fast, strong climbing, one-man (with machine gun) "Pursuit" machine, and that of the larger machine capable of considerable radius of action, and of carrying a load of bombs, and of fighting an aeroplane whether it be in front or to the rear.

The present 2-place reconnaissance tractor, with the pilot in rear and an observer in front, who is, for better observation, unhampered by controls, appears to be UTTERLY AT THE MERCY OF AN ATTACKING AEROPLANE. It would be powerless before either of the other two types mentioned, which could, however, perform satisfactorily every function of our standard machine, the pursuit machine for short-range work and the larger machine for "great distance" duty.

THE PURSUIT TYPE.

The so-called pursuit machine will be a most "handy" type. By virtue of its tremendous speed and climbing ability it can quickly overtake its enemy, and by virtue of its "controllability" it can dodge and outmaneuver its larger enemy, maintaining an effective fire with its machine gun, at the same time presenting to it a small and bewildering target.

This is an ideal machine, also, for "tactical" reconnaissance. It can locate targets for field artillery fire with rapidity and precision. It can even drop a few small bombs where they will do the most good.

In operating against an enemy of the United States this machine would be used not only over land, but also to drive off hydroaeroplanes sent in by an attacking fleet to locate our shore batteries.

The conditions governing the general design of our pursuit machine would be more like those in the present European war than those covering the design of any other type. Therefore, we can safely follow the most successful European practice in machines of this type as exemplified in the Fokker (ours will be biplanes, however), the Nieuport, the Vickers, the Bristol, the Sopwith, and the Martinsyde. All of these machines now use seven or nine cylinder rotary motors, developing 80 to 130 h.p. In spite of all theories to the contrary, it appears that the rotary motor has, at the present date, at least, *not* been discarded. The 130 h.p. Clerget, the German built Gnome (Ober-Osel), using the old valve arrangement, the French LeRhone, and the Gnome, single valve so popular with English pilots, are still used to a very great extent—and successfully.

The very light 8-cylinder V, water cooled, 150 h.p. Hispano-Suiza is being used by the French for this type of machine.

THE SECOND OR LARGER TYPE.

Considering the second and larger type, and the proper power for its motors, the reader's attention is invited to an article "The Development of the Military Aeroplane," by F. W. Lanchester, which appeared in London *Engineering* of March 3, 1916, in which was discussed the limiting "gross" weights of aeroplanes carrying certain military loads to obtain the maximum radius of action for each type. We may take exception to certain of the author's basic assumptions, but his method is certainly interesting and well worthy of consideration. In order to check his numerical values, two representative machines of type 5 in Table B were selected. For this machine (about 130 h.p., carrying 475 lbs. military load, fuel for 5 hours, and capable of slow speed with this load of about 45 miles per hour, and a factor of safety on the main plane girder of 7 to 8, the gross weight being 2400 to 2500 lbs.), it appears that the following is a fair estimate of weight percentages of the different grand items of the complete system:

TABLE A

	Percent of total gross weight
1. Aeroplane without power plant, fuel, or military load but including main planes, fuselage, fuel tanks, chassis, control and auxiliary surfaces, etc.	31
2. Power plant, 130 h.p., including motor complete (without oil), radiator, water, propeller, etc.	31
3. Military load including pilot, observer, instruments, machine guns, ammunition, bombs and racks, radio set, camera, etc.	19.5
4. Fuel load, gasoline and oil for 5 hours' flight at full power	18.5

Following Lanchester's general method, with changes in numerical values based on modern practice, as set forth in Table A, we find that, by sacrificing to some extent, but not beyond safe limits, speed range and climb, we can carry 900 to 1000 lbs. military load, at least half of which may be bombs, and fuel for 5 hours, in a machine of gross weight, loaded, 5000 lbs.

Now we know that, by care in design, we can build a machine with sufficient reserve power if we do not impose more than 19 to 19.5 lbs. per h.p. If we establish this proportion for full load conditions, we will have more reserve power as

the load becomes less during flight. Thus it appears that 260 h.p. is sufficient for a machine starting on a five hours' flight at full speed with 950 lbs. military load. The radius of action of the machine of Type 4 in Table B would be 400 to 425 miles at full power, or 550 to 600 miles if flown with motor throttled at the speed for maximum fuel economy, i.e., the maximum number of miles through the air per gallon of fuel. If, on this machine, we should carry only 650 lbs. of military load, we could, in carrying the additional 300 lbs. in fuel, fly almost 600 miles in 7 hours, or about 800 miles (throttled) in 12 hours.

Thus it appears that a machine of 260 h.p. should fulfill almost every military requirement not possible to the small pursuit machine.

The power, 260 h.p., may be obtained from 1 or 2 units.

For the present, at least, we can not hope to obtain a thoroughly developed motor of over 200 h.p. Our only alternative, then, is to use 2 units of 130 h.p. each. These will probably be of the 6 cylinder vertical, water-cooled type. The advantages of the 6 cylinder type over the 8 cylinder will not be discussed here. The most important advantage is that of less vibration because of better balance of accelerations of reciprocating parts. The most successful fixed cylinder motors known, the Mercedes, the Benz, and the Beardmore-Aero-Daimler, are of the 6 cylinder type.

It appears that the Caudron twin—LeRhone—motor machine has proven that the twin motor type is a possibility. Many new problems appear in the development of this type for the designer to solve, but nothing prohibits a successful design. The greater period of oscillations should provide a steady platform for gun fire and for bomb sights. We must, however, provide extraordinarily powerful lateral and directional control to handle the great moments of inertia.

Let us consider the versatility of a machine of this type. In the twin 130 h.p. motor, total 260 h.p., with a wheel undercarriage, we may place the pilot with his controls in the rear cockpit, in rear of the propellers; the observer, with his machine gun and bomb sight, in the forward cockpit, forward of the propellers, and the bombs and gasoline between pilot and observer near the center of gravity of the complete system. We now have a "Bomber" capable of acting independently. The observer has an ideal field for observation and for gun fire forward, either side, above or below. If we install an automatic stabilizer, the pilot can fight a machine to the rear, either side, above or below. If we carry only gasoline enough for 600 miles' flight, we can carry almost 500 lbs. in bombs.

By varying, however, bomb and gasoline, we can by sacrificing bomb weight, increase the radius of action, and vice versa. If we reduce our weight of bombs to, say, two of 50 and 75 lbs., we have an ideal extreme long range, or "*strategical 2-man reconnaissance machine*," capable of defending itself from an attack on any side.

Now, by making slight changes within the fuselage, which need not affect the fuselage structure, nor necessitate changes in any other part of the machine, we may place a third man in a position near the center of gravity, put controls in this third cockpit, and allow the front man and the rear man to devote all their energies to fighting with machine guns, or even with heavier armament, to dropping bombs, sketching and signaling. And we have an ideal "*Combat*" machine to act as escort to our bomber.

If we do not carry a third man or a great weight in bombs, we may replace the landing wheels by two or three pontoons and obtain a military *hydroaeroplane*, which should be very versatile in its functions.

For most of its flights, whether over land or water, this machine would carry, in addition to its other military load, a radio set.

We have compiled a table which comprises estimates of the percentages of the demands of aeroplanes of the various military types. It will be noted that Type No. 4 is to be used not only as a bomber, combat machine and extreme long-range reconnaissance machine on land, but also for the same purposes equipped as a hydroaeroplane.

ADDITIONAL SPECIAL TYPES.

We have not included in this list machines especially designed for operation as tactical or strategical scouts over mountains or forest-covered country. There is a large amount of such country in the United States, and it seems that the conditions for landing in, and getting away from, restricted areas in such country may necessitate special designs of aeroplanes. In order that these aeroplanes may possibly land in narrow roads at very low speeds, the gross weight will be very low and the span will be very small. This will mean that they will probably be low powered and have main planes of low aspect ratio.

Future military service may also require twin motored machines for carrying very large bombs or for extreme long range duty as seaplanes. It appears that a reasonable estimate

TABLE B

Type	Horsepower	Pusher or tractor	Number of men	Military load	Fuel load	Miles radius of action—full power	Climb, feet in 10 mins.	High speed, miles per hour	Low speed	Factor of safety	Percentage demand in war
1. Land primary school, also can be used for field artillery fire control	80	T	2	375	150	195	2600	66	37	7.5	25
2. Land advanced school, possibly mountain and forest tactical reconnaissance	100	T	2	400	240	300	3000	75	43	7.5	20
3. Land pursuit machine	110	T	1	200	150	315	8000	115	55	6.0	21
4. All-around machine, twin-motored, land or water	260	T or P	2	1100 to 550	600 to 1150	450 to 600	3400	90	47	6.5	28
5. Land reconnaissance machine used when no enemy aeroplanes	130	T	2	475	450	415	3400	82	46	7.0	2
6. Land gun-carrying machine	130	P	2	500	425	360	3100	77	45	7.0	4

for the units to be put on these twin motored machines will be about 180 h.p. (total, 360 h.p.), and the motors will probably be of the 12 cylinder V water cooled type.

It may be that, in addition to these types, a primary training aeroplane, the prototype of the French school "Penguin," should be designed and developed with a view to driving it with a standard automobile motor of, say, 70 h.p. (full speed). This motor would probably be run normally at speed to give about 40 h.p. The power plant complete, would weigh about 750 lbs.

Machines of such a type might be turned out quickly and in large quantities in case of emergency need for training a large number of novices rapidly, as at the outset of war.

It is believed that the development of a standard fuselage for the large twin motored, all-around type, to be the same for combat, bomber, or extreme long range reconnaissance, and for hydro work, is a problem demanding immediate attention. This fuselage should contain seats for pilot and passenger, controls, fuel tanks, bomb racks, extra fuel, tanks to replace bomb racks for certain duty, mounts for two machine guns, bomb sights, map desks, navigation and flying instruments, stabilizer, etc.

TABLE C

DEMANDS FOR MOTORS FOR THE ABOVE TYPES

Horsepower	Percentage of Demand
80	19.5
140	15.6
110 (rotary)	16.4
150	48.5

Lieutenant-Colonel George O. Squier

Lieutenant-Colonel George O. Squier, in charge of Aviation in the United States Army, has been connected with aeronautics ever since 1907. In that year he drew up specifications for an aeroplane for the United States Army, and it was these specifications with which the brothers, Orville and Wilbur Wright, complied when they delivered to the United States Army the first aeroplane any army ever owned. On September 12, 1908, Colonel Squier was the first passenger to make a flight in this machine, in fact, this flight of 9 minutes and 6 seconds was the first flight in which the Wrights ever carried a passenger.

It was in the town of Dryden, Mich., that Lieutenant Colonel Squier was born. In the year 1877 he graduated from West Point, seventh in a class of sixty-five. He chose the signal corps as the arm of the service that he would devote himself to, and his inventions in the fields of wireless and wire telegraphy and cable work, which are in use to-day almost throughout the world, have justified the choice.

In June 1915 he announced that he had perfected a method of submarine cable communication which the British authorities, who have tested the apparatus, say increases the efficiency of every submarine cable from 50 to 100 per cent.

Wireless telephony owes a great deal to Colonel Squier's genius and in recognition of his services in this field, he has been elected a member of the Royal Institution of Great Britain.

LIEUTENANT-COLONEL GEORGE O. SQUIER

An entirely new field of electrical intercommunication has interested Colonel Squier also, and he stands almost alone in knowledge of and accomplishments with wired-wireless. Through this invention he has made it possible to send wireless messages outside a telephone wire, yet guided by it. Half a dozen messages of different wave frequency can be handled by one wire at the same time. This invention is peculiarly applicable to war-time use, and is, in fact, being used by several of the European belligerents. With the old-fashioned field telegraph breaks in the wire invariably interrupted all communication. Enemy shells have been the chief causes of these interruptions in the modern trench warfare which is being waged in Europe. But, after Colonel Squier's invention was adopted, the messages did not fail to pass the gap caused by a breakage in the wire which guided their course, and communication remained uninterrupted. This invention Colonel Squier patented in the name of the people of the United States, and in their name the patent stands in Washington to-day.

For the past four years Lieutenant-Colonel Squier has been military attache at the American Embassy in London. Two of these years have been years of war. He has had an exceptional opportunity to witness the development of the British army from a small nucleus of professional soldiers to a grand nation-wide institution of more than 4,000,000 men, raised through a system of universal conscription. As a signal corps officer, the development of the air service has attracted the larger part of Colonel Squier's attention. His own inventions in the wireless, in wire and cable fields had interested the British signal corps in his work long before war was declared. He was on terms of intimacy with practically all of the British signal corps officers when hostilities commenced, and consequently he has been afforded opportunities to learn at first hand the lessons which the war is teaching. He has studied thoroughly the training of recruits, he has seen the trenches in France time and again, and he has visited Sikhs and Gurkas who were making hand grenades out of marmalade jars within sound of the mighty cannon at the front.

His early connection with aeronautics led him to take especial interest in England's air service. He has made special note of its failures and defects, he has drawn his own conclusions about its successes. When the authorities were looking for an officer of training and experience to handle the work of creating an air service for the United States, they happily concluded to order Colonel Squier home from England. He is eminently fitted for his work.

Reported Plans of the Aviation Section

Announcements made by the War Department and recently published in the New York *Times* tell some of the plans of the Officer in Charge of the Aviation Section of the Signal Corps, Lieut.-Col. George O. Squier, for building up the Army Air Service and training the regular army pilots as well as the reserve military aviators provided for in the recently enacted bill to provide for National Defense.

A progressive system of training has been carefully planned, which will lead the student of flying from very easy flights under ideal weather conditions by simple and natural stages up to the point where he is ready to take his Junior Military Aviator's or Reserve Military Aviator's certificate.

The scheme of instruction has been in effect since the establishment of the present school at San Diego, and it is the system that in all of its principal details is to be followed in the training of military aviators.

"It seems to be the opinion, obtained through articles which have appeared from time to time in various newspapers," an officer of the aviation section said in an interview printed in the *Times*, "that any civilian who goes to a civilian school of aviation and attains the Aero Club of America's license is a pilot in the full sense of the word, and that such a man is available on obtaining that license for the Government service in any capacity and at a moment's notice. Such, however, is far from the case. The average civilian school limits its instruction to 400 minutes, and the pupil is supposed during that time to learn to pilot a machine alone under the best possible, and not adverse, conditions. With the improved types of machines that now exist it is possible in most cases to accomplish this and to pass the test for an Aero Club certificate.

"As a matter of fact this certificate indicates nothing except that a man is able to leave the ground in a machine in good running order under air conditions that are the best and to return safely to the ground. At this stage the student should be only beginning his instruction, as practically everything that the student learns must be taught from this time on, when he is piloting a machine alone. In other words, the civilian school stops at the point where the United States Army preliminary training ends and the real instruction begins.

"As fast as commissioned the reserve aviators will be assigned to reserve squadrons, one company being allotted to each divisional district into which the country is now divided. This means that New York State, which forms the territory of the Sixth Division, will have a company all to itself, as will also Pennsylvania, another State which forms a complete division.

"Each one of these squadrons, in turn of point, will have a depot unit of several officers and twenty or thirty enlisted men on active duty all the time. The rest of the personnel of the squadron, which will number about 20 officers and 150 enlisted men, will be assigned at certain times, when they will report for actual field practice. For instance, in the New York Division the training station will probably be at Mineola.

"Not only will these officers of the reserve, who are expected to total about 500, be required to fly at regular stated periods, but their instruction will be continuous and will lead up to the most advanced stages in military aviation, such as combat work, bomb dropping, photography, wireless signaling from the air—in fact, it will include every detail of instruction that goes to make the efficient military pilot and observer of the present time.

"Certain types of machines will be selected for each squadron in the country, and certain manufacturing plants will be contracted with to keep them supplied with new and up-to-date material, while another supply will be held in reserve ready for use in case of emergency. The enlisted personnel of these squadrons will, in addition to their training at army stations, be also assigned to various factories and plants where they will receive mechanical instruction under actual manufacturing conditions."

ARMY AEROPLANE TESTING AND EXPERIMENTAL STATION

Lieut. Col. Squier, in charge of aviation in the United States Army, has also announced that the War Department is preparing plans for a permanent experimental and inspection station for the use of the Aviation Section of the Signal Corps. Congress has appropriated $300,000 for the site. Civilian engineers, in charge of Henry Souther, one of the country's best known authorities on the gasoline motor, will work with the Army men at the plant.

The purposes to which this plant and proving ground will be put, as stated in an official memorandum to Colonel Squier, are as follows:

Testing aeroplanes made by manufacturers throughout the country for climb, speed range, controllability, stability, etc. Correcting faults and weaknesses in such aeroplanes brought out by tests, general development, and improvement.

Testing aeroplane motors on the stand for power, endurance, reliability, fuel economy, etc. Correcting defects in power plants brought out by tests.

Testing aeroplane motors in flight (mounted in standard or experimental aeroplanes) for general suitability and correcting the faults developed.

Developing inventions pertaining to aviation when inventors cannot afford to do so.

Testing in flight instruments and accessories pertaining to aviation made by manufacturers throughout the country. Correcting faults in these brought out by tests.

Making (from designs of full scale aeroplanes) exact models and testing them in the wind tunnel for aerodynamic coefficients, resistance derivatives, and rotary resistance derivatives, from which the degrees of symmetric and assymetric stability (statical and dynamical) may be calculated.

Designing, constructing, testing and developing by progressive remodeling aeroplanes of various types, designing new types and improving old types. It is entirely possible that as results of such work complete factory drawings of service aeroplanes could be made that would permit in an emergency, furniture manufacturing firms and sheet metal working shops to make all parts of these machines ready for assembly.

Designing, building, testing and developing radio equipments for aeroplanes.

Designing, building, testing and developing machine gun mounts, bomb dropping devices, etc. An officer of the Ordnance Department should be detailed to help in this work.

Designing, making, testing and developing instruments and accessories pertaining to aviation.

Testing balloons, captive kite, dirigible, etc., made by manufacturers throughout the country. Correcting faults and weaknesses in balloons brought out in tests.

Instructing and training inspectors (to reside at factories where machines are being built to our order) in testing materials, calculating stresses, and in distinguishing between good and bad practice in structural details, etc. Through the medium of a well trained corps of inspectors, in addition to insuring structural integrity, proper quality of material and grade of workmanship in machines for our service co-operation between manufacturers and the army, making for improvement in the products of both, could be effected.

The experimental and inspection department should include an intelligence bureau whose function it would be to obtain from our foreign attaches and from foreign technical periodicals, etc., the reports of progress in the science made in Europe, and to translate, file and index such reports for reference.

An Australian Hangar

The New South Wales State Government has a complete aviation school at Richmond, N. S. W. The illustration shows a hangar at the school. The construction is interesting. The doors, it is easy to see, are hoisted in six sections.

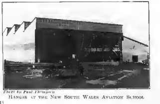


Photo by Paul Thompson

HANGAR AT THE NEW SOUTH WALES AVIATION SCHOOL

The Training of Military Pilots

By Lieutenant Phillips Rader

Military aviation is still in its infancy. At present no one can predict the possibilities of its future. It is a vast subject, covering practically every branch of military service, and requiring every form of technical knowledge and engineering skill.

Let us start with the efficient army pilot. The others absolutely do not count.

In this present war, the army pilot has to be the most versatile individual in the entire service. His duties embody everything. He must first, and above all, be a trained soldier. He must have a rigid military training in order to cope with a military enemy. To-day to send the average civilian pilot over the lines, regardless of his skill, would be almost murder. If he did return safely, he would be useless. Could he tell how many battalions he saw on the march? The approximate number of rounds of ammunition in a supply train? The caliber of a heavy gun? Could he distinguish an occupied trench from a communication trench? Could he describe in detail the latest defenses he saw, and the latest feat of the enemy engineers? Could he, above all, range a heavy gun on a certain target behind the enemy lines? Could he understand the wireless and signals to and from the battery he was working with? Could he cope with an armed enemy machine? This a courageous civilian *might* do, but in the rest he would be worthless.

Actual flying is only a very small part of the training a good service pilot needs to-day. He should have at least six months mental and technical training before he is even allowed near a machine.

A man training to be a military pilot, if not previously a soldier, should attend a military academy or receive instruction from experienced army officers for at least six months. He should be drilled in the various formations of troops. He should know the exact number of men in a company, the number of companies in a battalion, the number of battalions in a brigade, and the number of brigades in an army corps. What is most essential, he should know to a nicety the exact amount of space covered by a company of soldiers marching four abreast. He should also know the number of transports in a divisional supply column. He should be able to tell, say, from a height of 12,000 feet, the caliber and number of guns in an artillery column on the move. He should develop the knack of picking out concealed guns and concentrated batteries in hidden places. He should be able to judge the strength in men of an entrenched camp, and also the approximate number of men in a garrison. *Then* the pupil should be taken out in the field and be given rigid instruction in entrenching and earthworks. He should be shown all the various methods of the concealment of artillery and armaments. All these details are *most* important.

The next step (after the pupil has proven to his commanding officer his ability in the above subjects) is to put him through a course of wireless. He should learn the Morse code thoroughly, and also the private codes of his army. He should pass written examinations in the construction and theory of wireless telegraphy and telephones. He should be capable of installing an entire set himself. He is then ready for the next step.

The pupil should now be sent on a two weeks' course in a machine gun school, where he is instructed on the cleaning, taking down and putting together of the latest types of machine guns. He should know which part is liable to jam in the air, as ignorance on this subject could easily cost him his life in an aerial combat.

His next move is to gain a practical working knowledge of aerial photography, just when and where to take good pictures of military value.

Next comes instruction in engines. The pupil should know how to take down, tune, and repair every type of engine used by his government. He should have the practical knowledge his mechanicians have. The oiling system, magnetos, bearings and ignition should all be very carefully studied, as in forced landings this is a great asset, and will often save the government thousands of dollars. Gasoline consumption is another phase to be studied.

Rigging is almost as essential as motors. A good service pilot should know the stagger, dihedral, lift, balance and general dimensions on all machines in use in his unit. He should be able to tell at a glance whether a machine was rigged, or "trued up" properly. The tensile strength of various wires and struts should be known, and a general knowledge of aerodynamics is advisable. Fabrics and dopes should be studied and various woods studied for lightness and toughness. A week or so in a woodworking shop would suffice. Various turnbuckles and wire strainers, fittings, bolts and metals should be examined and studied for strength and elasticity. Various types of shock absorbers and safety appliances, such as belts, etc., should be noted, and the efficient ones borne in mind. When all of this is assimilated the pupil may be taken to an aerodrome for his first flights.

Nearly every instructor in aviation has his own special method. Some are excellent, and some are poor. Without commenting on the merits or demerits of my own system I have been through the experience of training hundreds of men to fly, and the majority have turned out excellent pilots.

In the first two trips I believe in accomplishing two things, viz., getting the pupil used to the air and height, and, secondly, showing what *can* be done in the air with an aeroplane with safety. This usually involves a few vertical banks, stalling, side slipping, gliding, diving, and if the type warrants it a loop or two. The pupil is now ready for his first real lesson. This usually consists of "straights." That is, to fly in a straight line, at a low altitude, land, turn around, another straight line and land again. Now this teaches the pupil three most important things: to take the machine off the ground properly, to hold a course, and, what is most important of all, to land correctly and slowly. As the average lesson is about 15 minutes in length, ten landings may be effected in a lesson with ease. Banking and turns comes automatically after that.

When the pupil has proven to the instructor that he is capable of landing properly, and also capable of a certain amount of control in the air, he is sent on his first "solo." This is the most critical period in the life of a pilot. For the first time he is trusted with about $6,000 worth of breakable property, and his own neck in the bargain, and he knows that it is up to him and him alone, to bring the machine to earth safely. Once in the air he is beyond all human aid. He must rely entirely on his own efforts. This accomplished, he does a few more practice flights and then qualifies for his aero club certificate. The pupil, having accomplished this and received his brevet, must not run away with the idea that he is now a pilot, as he is now at really a more dangerous stage than he was on his first solo. That is, he gets over confident and tries to do stunts that he has seen some experienced pilots do. This usually ends disastrously.

The pupil is now ready for higher instruction in aviation and is sent to an advanced school. Here he is instructed all over again on a faster (usually tractor) machine, and he has to undergo all the horrors of a first solo on a "real" aeroplane. Thus then, he graduates from one machine to another—and training on at least six types is advisable—until he is on fast, sensitive single-seater scouts. These are most difficult to land, and he is obliged to call all his skill into play. After about ten hours' practice flying he is ready for his first cross-country flight. For this I should recommend a triangular course of about sixty miles. This forces him to fly by his compass—a most valuable asset in fog and clouds. If he is successful on this trip, one should give the pupil climbing tests, altitude work, and instruction in bomb-dropping with various types of bombs. Lectures by an expert should be attended. Map reading should be studied thoroughly, and too much time cannot be devoted to this phase, as he would be in continuous danger over enemy territory should he become confused with his compass and maps.

Night flying is another very important and most difficult branch of military aviation. In England to-day as many pilots are being trained for night work as service pilots are being trained for the front.

After all of these various phases have been learned and accomplished then, and not before, is a man qualified to be called an efficient service pilot. There is indeed a survival of the fittest, but nevertheless a good service pilot is *made*, *not born*.

Theory of an Aeroplane Encountering Gusts*

(Longitudinal Stability)

By Professor E. B. Wilson

Reviewed by Alexander Klemin

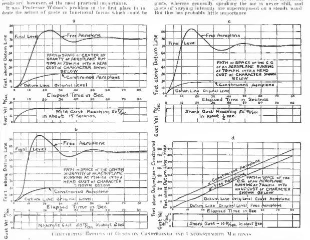
It is not proposed to indicate in any detail the mathematical methods which Professor Wilson employs in his brilliant analysis. For an understanding of these methods, long preliminary study of aeroplane stability treated in the now classical fashion of Bryan, Bairstow and Hunsaker is necessary, and even then the complete grasp of the paper would require far more time and effort than the busy aeronautical engineer can afford. Its results are, however, of the most practical importance.

It was Professor Wilson's problem in the first place to indicate the action of gusts in functional forms which could be introduced into the differential equations of motion of the aeroplane, so that the latter might admit of ready solution. For this purpose the author approximated the growth of the gusts to that of exponential functions with varying indices, to parallel gusts of greater or lesser rapidity of growth. It might be objected that gusts do not follow any exponential function nor any regular function and the mere mention of such a function drew a smile from a very eminent meterologist.

Yet if the exponential curves are compared with actual metereological gust records a decided resemblance in form will be noticed.

It is true that no gust ever rises to a maximum and stays there, still the study of the effects of gusts of exponential form gives a very fair idea of what would be the behavior of a machine on striking a gust of similar character in flight, and a still better method of comparing the behavior of machines provided with a gyroscopic stabilizer, and of machines when unconstrained.

The assumptions of the paper also differ from the facts of nature in so far as the air is taken to be still with occasional gusts, whereas generally speaking the air is never still, and gusts of varying intensity are superimposed on a steady wind. But this has probably little importance.



COMPARATIVE EFFECTS OF GUSTS ON CONSTRAINED AND UNCONSTRAINED MACHINES

The actual function was of the form $J(1-e^{-rt})$†, where J was the maximum velocity in feet per second attained. The greater the value of r, the quicker the value of e^{-rt} diminishes, and the sooner is the maximum value attained. This function is taken as superimposed on the natural oscillation of the machine. The equations of motion are solved by standard mathematical methods involving considerable labor. Expressions for rectilinear velocity in horizontal and vertical directions, and for rotary or pitching velocity are deduced; these integrated in turn give the path in space of the machine and also its acceleration.

The calculations have been carried out for longitudinal stability only, with special reference to the Curtiss JN2, a machine with a moderate degree of longitudinal stability, in two cases:

1. A machine uncontrolled by the pilot, and unconstrained by any mechanical stability device.

* A digest from the First Annual Report of the National Advisory Committee for Aeronautics.

† e is the exponential 2.71828, r is some constant, and t is time in seconds.

2. A machine uncontrolled by the pilot and constrained by a gyroscopic stabilizer designed to maintain a constant angle of incidence with the earth's horizontal, and to keep the plane of symmetry of the machine in the vertical.

In both cases the problem is considered with (a) mild, moderate and sharp head-on gusts, (b) mild, moderate and sharp up-gusts, and (c) mild, moderate and sharp rotary gusts in a longitudinal plane. It is assumed that tail-on and down gusts can be treated in the same manner by reversing the sign of J, and that they will give opposite results to those of the head-on and up gusts.

Results of the Investigation on Head-on Gusts

In both the constrained and unconstrained machines the vertical accelerations produced are not serious. The oscillations in the horizontal velocity and in pitching velocity, eliminated in the constrained machine, are not of great importance in the unconstrained stable machine. This might not be the case, however, for an unconstrained machine longitudinally unstable, where such oscillations might become very large. In spite of the labor involved, it would be a useful investigation to work out the effects of such gusts on a machine frankly unstable longitudinally but gyroscopically constrained.

Still more interesting is the study of the actual paths of the machine when struck by gusts of this character as plotted in Figs. a, b, and c. Here the constrained machine shows to considerable advantage. The unconstrained machine struck by gusts of varying intensity, shows a path oscillation of some seventy seconds duration, after which period it attains for a gust of maximum intensity of 20 feet per second, a steady horizontal motion about 70 feet above its original position. Initially, however, the vertical displacement is as much as 95 feet above the original position, in the first 15 seconds. It is true that 15 seconds or even a fraction of this period give ample time to the pilot to operate his controls.

If instead of head-on gusts, the aeroplane struck tail-on gusts, and fell 95 feet in the first 15 seconds, there would, in flying low, be an element of considerable danger, which would be very much greater still for the unstable machine. The constrained machine on the other hand has no path oscillation at all, as shown in the same figures, and rises to a higher level of only 20 feet or less above its original position. It would be interesting to investigate the case of an unstable machine equipped with a stabilizer.

Results of the Investigation on Up-Gusts

Here the oscillations in horizontal and pitching velocity were unimportant. For both the constrained and the unconstrained machine, there are shown to be violent vertical accelerations of a maximum possible value of 1.5 J or about 30 feet per second. While the stresses introduced thereby would be easily met by a machine of standard design there would be nevertheless an unpleasant "bump" for the pilot, which constraint would not remove.

The main effect of the up-gust, as shown in Fig. d, is to give the machine a steady upward motion or downward in the case of a down gust. Improvement would not be effected in this respect by the use of the stabilizer.

Rotary Gusts

Owing to lack of metereological information on intensity and duration, the rotary gusts postulated are somewhat hypothetical. Professor Wilson concludes, however, that if the air is considered as a solid body whirling with a velocity of 20 feet per second and a whirling radius of 160 feet its effect would be considerably greater in the case of an unconstrained machine than that of a head-on gust of the same velocity. The effect of a combined rotary and head-on gust would be very serious. The gyroscopic constraint would eliminate all effects of the rotary gust, another distinct advantage in favor of the stabilizer, particularly when the machine is flying low, where the proximity of trees and buildings must of necessity introduce severe rotary gusts.

Another conclusion of Professor Wilson's is that a sharp head-on gust is about half as effective as a moderate up-gust. This emphasizes the importance of the study of up-gusts so frequent under certain meteorological conditions, such as the dividing line between warm air over the sea and cold air over the shore and vice versa.

When the effects of lateral gusts for both types of machines on lateral stability have been worked out, and possibly when the one or two other problems have been solved, it will be possible to arrive at some fairly definite conclusions as to the behavior in gusts of any character of the unstable machine, the unstable machine controlled by a stabilizer, the stable machine, and finally the stable machine controlled by the stabilizer.

Some meteorological data interesting from this point of view is already available. Most valuable information is given in the British Report of the Advisory Committee for Aeronautics, 1911-1912, Report No. 47 and 1912-1913, Report No. 92-93. These provide for the aviator and the aeroplane designer some idea of the intensities of the gusts to be met with in a temperate climate such as that of England, which may be very fairly taken as a basis for similar conditions in certain parts of this country.

Reply to Correspondent

Ornithopters

W. H., New Jersey. Answering your queries concerning ornithopters, we suggest:

(I) That ornithopters have not achieved any measure of success hitherto, although numberless models have been built.

(II) The problem for the ornithopter or flapping type of heavier than air machine is one of efficiency. It is commonly thought that the propeller driven apparatus will always be more efficient.

(III) Even if an efficient type of ornithopter is designed, it is thought that it will always be an extremely complicated mechanism. Numerous patents have been issued on this type of machine, and it would involve several days' research to collect such patents. You will find information on this type in the following books available at large libraries:

Victor Lougheed's Vehicle of the Air, p. 25 and p. 124.
Dr. A. F. Zahm's Aerial Navigation, p. 374.
F. Walker's Aerial Navigation, p. 24.

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PLACING A LARGE BOMB ON A WARPLANE

The Dusenberg Aero Engine

One of the largest and most powerful aero engines yet built has recently been completed at the works of the Duesenberg Motor Co., Chicago, Ill. It is the design of F. S. Duesenberg, whose success with high-speed automobile engines is well known, and who two years ago produced the pair of exceptionally powerful marine engines of the 12 cylinder, all in line type, for Disturber II.

The aero engine is of the 60°-V pattern, with 12 cylinders of 4¾-inch bore and 7 inch stroke. Its full speed is 1400 revolutions per minute, at which it is expected to develop 300 horse power. The weight, with starter, generator, etc., ready to run, is 1040 pounds. The piston speed is comparatively low which, combined with lightness of reciprocating parts and with the self-balancing properties inherent to "twin-six" construction, will lead to minimum vibration. The propeller is mounted on the crank shaft, thus running at engine speed. To hold the speed down to 1400 revolutions per minute the engine will have to swing a very large propeller which suggests that it is designed for aeroplanes of great size.

Pistons and connecting rods of this engine are made as light as possible consistent with strength and wearing quality. The pistons are of Magnalite, an alloy of aluminum, well ribbed to support the bosses and the piston crown and to aid in conducting away the heat. The rings are of special, three piece type, with wide surfaces where they bear against the groove, to prevent rapid wear of the alloy. Wrist pins turn in the pistons, without bushings.

The connecting rods are forgings of chrome nickel steel, first roughed out, then annealed and machined all over, to within 1/32 inch of final dimensions. They are then heat treated, machined and ground to size. The finished rods are of hollow section, tapering very slightly, with all corners liberally filleted. The bearings at the crank-pin ends are of Non Gran bronze, babbitt lined. Four bolts are used at the crank-pin end of each rod.

As in all Duesenberg motors, the valves are in the cylinder head with both inlet and exhaust on the same side of the cylinder, and with the valve stems perpendicular to the cylinder axes. This arrangement would bring the valves horizontal except for the cylinders being inclined. It has several advantages and has been well tried out in gasoline engines as well as in heavy oil engines of the Diesel type. The combustion chamber is favorably shaped for easy entrance and escape of the charge, and makes possible an effective cooling of the valve seats. It also guards against having a valve fall into the cylinder when the stem breaks, as has occurred in engines of the ordinary valve-in-head pattern, where the stems are vertical.

At only 1400 revolutions per minute there is no difficulty in getting sufficient valve area and yet making the lift small. Each valve has two concentric springs, in this respect not being as in the illustration. A split collar fits into a

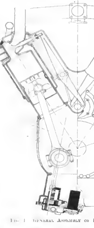

FIG. 1. GENERAL ASSEMBLY OF DUESENBERG ENGINE

FIG. 2. UPPER HALF OF CRANKCASE, FROM BELOW

groove in the valve spindle and is locked in place by the collar against which the spring acts. The valves are operated by long rockers of very light section, having hardened "wipers" instead of rollers at their lower ends against which the cams act. The cam shaft, in the angle of the V, runs in a sort of trough which catches oil forced through the bearings, so that the cams dip into oil at every revolution.

The crank shaft has four main bearings and six cranks, with the two connecting-rods side by side on each crank pin. This latter arrangement, used in most engines of the V type, requires that the cylinders be "staggered," and consequently makes the engine a little longer than if the crank pin bearings were as in the Renault engine illustrated in AVIATION

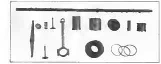

FIG. 1. GROUP OF PARTS OF DUESENBERG ENGINE

AND AERONAUTICAL ENGINEERING of August 1, but it allows all the connecting-rods to be made alike, and gives each a good bearing easily lubricated directly on the crank pin.

The shaft is unusually large and strong. Its diameter at all main bearings and crank pins is 3 inches, or 53 per cent of the cylinder diameter. The pins are 3 by 4½ inches, giving a bearing area of .16 square inch per square inch of piston area for each connecting-rod. Shaft and pins are bored hollow and are fitted with special oil tubes for the forced lubrication system. The finished weight of shaft is 160 pounds.

The crank case is a casting of aluminum alloy, very deep in section to secure rigidity. Its effective depth is increased by the oil-pan bolted on below. Large hand holes on each side

FIG. 4. EXTERIOR VIEW OF CRANKCASE

make all parts around the shaft accessible without removing the oil-pan. The main thrust bearing is housed at the propeller end, while at the other end are the cam-shaft gears and all auxiliaries. The weight of the crank case is 124 pounds.

At the lowest point of the oil-pan are two pumps, the lower one drawing oil through the strainer illustrated, and delivering it to an oil-cooler and supply tank. The upper pump receives the cool oil and forces it to all bearings. The strainer can be removed for cleaning without disturbing any pipe connections. The lower oil-pump keeps the crank case drained at all times, returning oil to the tank as fast as it comes through the bearings. The pistons and valves are lubricated by positive feed, which can be regulated at will.

The cylinders are semi-steel castings, weighing 51 pounds to the pair. The brackets supporting the valve rockers are part of the cylinder castings, so that a pair of cylinders can be removed, with their rockers, without deranging the valve adjustment. An aluminum cover of V-form houses the valve gear of each four cylinders, and helps to stiffen the engine.

The intake manifold is on top of the cylinders, making the carburetor accessible. Either one or two carburetors may be used. Ignition is by two 12 cylinder magnetos, mounted crosswise at the end of the motor, and driven by a worm gear from the camshaft. Each cylinder has two spark plugs.

The starter is carried on the timing gear cover, and has a simple device for throwing it in or out. Its gear ratio is 25 to 1. The generator has a Coventry chain driven 1½ to 1, from the crank shaft. All gears, including timer and starter,

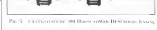

FIG. 5. CRANKSHAFT OF 100 HORSEPOWER DUESENBERG ENGINE

are made by the Harvey process, so that they are strong and durable, although very light. There are two circulating pumps, one for each six cylinders.

The Latest British Report (1915-1916)

An abstract of the latest report of the British Advisory Committee on Aeronautics has recently been published, which summarizes very briefly a year's work at the Royal Aircraft Factory and at the National Physical Laboratory. No doubt further information will not be forthcoming until the termination of the war, although that given is useful in showing the general trend of aeronautical development in England.

Certain portions of the report have a direct practical meaning for American construction. Mention is made of a fair shaped design of tail, indicating probably that a double cambered non lifting machine is now being employed for the stabilizer surfaces.

In large machines special attention has been given to the provision of suitable landing gear, and air and oil recoil mechanisms have been successfully introduced. The design of air and oil shock absorbers has received little attention hitherto in this country, and undoubtedly merits consideration at this stage of development. A steerable tail skid is mentioned this, however, being by no means a novel feature.

Actual experience in France has brought to the fore considerations of a military factor of safety and the instructions calling for a factor of six to be increased if possible to twelve, have been varied in practice. The expression varied in practice can only mean diminished in practice. Were such a diminution present in War Department or Navy Department specifications, as no doubt it would be in time of war, American practice as regards speed and climb would have considerable opportunity for improvement. Such a decrease in the factor of safety is no doubt an impossibility under present conditions, but it would be interesting and useful to build experimental machines of such a type.

Heavy wires of oval section and good aerodynamical properties known as rat-wires have stood vibration tests at the National Physical Laboratory after suitable heat treatment. As a further precaution against the effects of vibration, universally jointed fittings are employed.

Two new devices are said to be under test for improving performance at heights, but with regard to these devices and to other important matters the report is so vague as to be of comparatively small value as information.

RELATION BETWEEN VELOCITY OF THE GRADIENT WIND AND THAT OF THE OBSERVED WIND. J. Fairgrieve. (*Geophys. Mem.* No. 9, pp. 189-207.) In a preface by W. N. Shaw a discussion of gradient wind is given, also reasons for using it as a standard of reference. The chief object of the paper was to obtain better values for normal wind than those used by Guilbert in his system of weather forecasting. The following conclusions are drawn from the paper. Northeasterly winds are normally nearer the gradient velocity than others. If winds come over a considerable area of water, they are nearer the gradient velocity than if they come over land. Local conditions modify to some extent the strength of the wind.

A German Hydroaeroplane

A twin-motored German hydroaeroplane captured on April 8 in the North Sea, is the subject of an excellent article by Jean Lagorgette that has appeared in *L'Aerophile*. The interesting photograph shows the two German aviators taking to the water after having set fire to their machine. Three excellent assembly views reproduced herewith give a very good idea of the general construction, which is similar to the English Avro hydroaeroplane.

The two motors are 120 horsepower Mercedes engines and

FIG. 1. PHOTOGRAPH OF A CAPTURED TWIN-MOTORED GERMAN HYDROAEROPLANE, WHICH WAS SET FIRE TO BY ITS AVIATORS

the propellers are 8 feet 7 inches in diameter. For such comparatively large power the machine is of small dimensions. The German tendency since the beginning of the war seems to be to reduce dimensions for the same power. The passenger sits forward and the armament consists of a machine gun whose support slides on a circular tube surrounding the passenger as can be seen from the photographs and plan view. M. Lagorgette scores this arrangement as being rather unpractical. The main dimensions of the plane are:

Total supporting area	560 square feet
Span upper wing	[illegible] feet 3 inches
Chord upper wing	5 feet 11 inches
Span lower wing	48 feet 8 inches
Chord lower wing	[illegible] feet 11 inches
Gap	[illegible] feet 4 inches
Length overall	[illegible] feet 8 inches

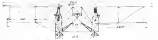

FIG. 2. FRONT ELEVATION. THE ENGINES ARE ENCLOSED IN A SEMI STREAM LINE FORM

Other dimensions are shown in the drawings. It is noteworthy that the length is not much more than half the span of the upper surface. Just as in their land machines, German practice seems to tend to a short moment arm for the tail surface, with large areas in compensation. The engine, body, and floats are all horizontal in normal flight, which is an excellent feature of the design. The whole machine is painted a very light blue, a useful color in seagoing craft.

WINGS, AILERONS, AND INTERPLANE CONNECTIONS

The total supporting surface of the wings is 560 square feet, which is very small for a hydroaeroplane of 240 horsepower, and the wing section, of small camber, is that suitable for a fast machine, and it is slightly upturned at the trailing edge. The wing spars are formed of glued laminations, an interesting and unusual method. A slight dihedral is employed, but it is worthy of note that the wings are only raised beyond the fixed central section, as shown in Fig. 2. It is difficult to say whether this is from aerodynamic considerations or merely for ease of construction. The extremities of the upper wing are raised about 7 inches and of the lower about 5.9 inches, but the difference is only due to the shorter span of the latter.

In plan form the wings are rectangular, the ailerons only projecting. The ailerons, as in the Albatros, are warped, their

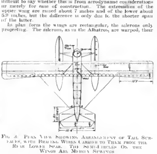

FIG. 3. PLAN VIEW SHOWING ARRANGEMENT OF TAIL SURFACES, WITH BRACING WIRES CARRIED TO THEM FROM THE REAR LOWER SPAR. THE SEMI-CIRCLES ON THE WINGS ARE MERELY SEWINGS

trailing edges being gradually warped as they approach the extremities of the wing. The interplane struts are of wood, and steel cables are used for bracing.

FLOATS

The floats are connected to the body by a number of well-disposed wooden struts and two steel tubes, all wires being dispensed with. They are carefully built and, like the whole machine, are painted a light blue. They are somewhat lengthy, but the tail float is dispensed with. Placed under the motors, their width between centers is 12 feet, which is little more than sufficient to give clearance to the two propellers.

TAIL SURFACES

The tail surfaces offer several peculiarities. The fixed stabilizer is of very large area; the elevator is in one piece, of considerable aspect ratio, the vertical fixed fin and the vertical rudder are duplicated at either side of the tail surfaces, and the rudder is balanced by a rounded surface placed forward of the hinge.

FIG. 4. SIDE ELEVATION SHOWING PROFILE OF WING SECTION WHICH IS SLIGHTLY UPTURNED AT REAR EDGE. THE BODY IS COVERED IN ONLY TO THE POINT A-A

The tail surfaces present a peculiar appearance, but should give a minimum interference between vertical and horizontal surfaces.

FUSELAGE

The fuselage is rectangular in form, and is divided into two parts just back of the pilot. The body is only cloth up to the point A-A shown in Figs. 3 and 4. Beyond this the body is of boxlike construction without cross-members.

No particulars of the performance of the machine are available, but the impression given is that of a very trustworthy and speedy hydroplane, likely to give a rapid climb.

Course in Aerodynamics and Aeroplane Design*

By Alexander Klemin, A.C.G.I., B.Sc., S.M.
Instructor in Aeronautics, Massachusetts Institute of Technology, Member of the Aeronautical Society of Great Britain and Ireland,
and
T. H. Huff, S.B.
Instructor in Aeronautics, Massachusetts Institute of Technology

PART I—SECTION 3

Flat Plates. Simple Problems on Sustentation and Resistance of Wing Surfaces

Coefficients of Resistance for Circular or Square Plates Normal to the Wind, Varying Sizes

Although it would seem that the question of the forces on a flat plate placed normally to the wind would be fundamental in aeronautics, and although it can be shown by the principle of dynamical similarity that similar plates should have the same coefficients no matter what their size, provided that H remains constant, yet considerable controversy exists as to the variation in the values with the size of plate and with the velocity of flow. Those who are interested in the controversial aspect of the question are referred to the references at the end of the section. For all practical purposes, the following table may be safely used

$R = KAV^2$ where R = resistance in pounds
A = area of plate in square feet
V = velocity in miles per hour.

TABLE 1

Side of Square or Diameter of Circular Plate in Feet.	K
0.5	.00269
1.0	.00286
2.0	.00314
3.0	.00322
5.0	.00327
10.0	.00327

Coefficients for Rectangular Flat Plates Normal to the Wind. Varying Aspect Ratio

The aspect ratio of a flat plate is the ratio of b to a as shown in the Fig. 1. With increased aspect ratio the resistance coefficient increases. A thorough theoretical discussion of this involves tremendous difficulties but the increase is probably due to the fact that with increased aspect ratio the air flow is broken up into a greater number of vortices, with a resultant greater turbulence. The following table shows the effect of increased aspect ratio, according to experiments by Eiffel. The coefficient for a square plate of the same area is taken as unity.

FIG. 1. ASPECT RATIO FOR A FLAT PLATE NORMAL TO THE WIND

TABLE 2

Aspect Ratio	K for Rectangular Plate / K for a Square Plate
1.0	1.0
1.5	1.04
3.0	1.07
6.0	1.10
10.0	1.15
14.6	1.25
20.0	1.34
30.0	1.40
50.0	1.47

These values are plotted in Fig. 2 and are assumed to be true independently of the size of the plate.

* This Course commenced in the August 1, 1916 issue of AVIATION AND AERONAUTICAL ENGINEERING will be completed in 24 issues. It will embody the fundamental aeronautical data necessary for aeroplane design and present the design of standard machines in complete simple and systematic form.

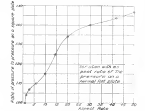

FIG. 2. VARIATION WITH ASPECT RATIO OF THE PRESSURE ON A NORMAL FLAT PLATE

Coefficients of Resistance for Flat Plates Inclined to the Wind

Table 3 gives values for K_y, K_x, and L/D, and Table 4 the distance of the center of the pressure from the leading edge of the plate in terms of the chord, for flat plates of various aspect ratios. The drag at 0 may be calculated from Zahm's formula for skin friction.

TABLE 3

Aspect ratio 1				Aspect ratio 6			
Angle	K_y	K_x	L/D	Angle	K_y	K_x	L/D
7	00147	00007	[illegible]	6	00090	00011	7.6
10	00207	00010	7.1	10	00140	00028	5.1
20	00208	00074	2.8	20	00211	00077	2.7
30	00294	00174	1.7	30	00191	00111	1.7
47	00207	00210	.98	40	00140	00225	.39
90	00180	00247	.77				
Aspect ratio 1.5				Aspect ratio 5			
Angle	K_y	K_x	L/D	Angle	K_y	K_x	L/D
10	00100	00020	5.0	6	00103	00018	[illegible]
20	00217	00077	2.8	10	00173	00011	7.2
30	00188	00097	1.7	20	00198	00071	2.7
40	00182	00152	1.2	30	00214	00121	1.7
90	00127	00228	.57	90	00141	00211	.38
Aspect ratio 3				Aspect ratio 4			
Angle	K_y	K_x	L/D	Angle	K_y	K_x	L/D
6	00074	00010	7.4	6	00137	00026	5.2
10	00127	00021	7.0	10	00180	00010	4.7
20	00247	00091	2.7	20	00211	00080	2.6
30	00178	00111	1.7	30	00210	00127	1.7
40	00160	00146	1.2	90	00140	00251	.55
90	00120	00227	.61				
Aspect ratio 1/3				Aspect ratio 1/6			
Angle	K_y	K_x	L/D	Angle	K_y	K_x	L/D
6	00033	00007	4.4	6	00020	00007	4.0
10	00059	00011	4.2	10	00040	00010	4.0
20	00138	00071	2.0	20	00114	00017	2.6
30	00219	00112	1.7	30	00176	00102	1.7
47	00246	00250	.98	47	00217	00217	.99
90	00177	00254	.78	90	00211	00282	.38

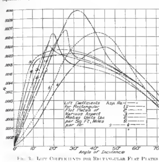

FIG. 3. LIFT COEFFICIENTS FOR RECTANGULAR FLAT PLATES OF VARIOUS ASPECT RATIOS

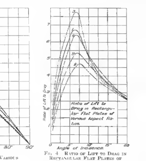

FIG. 4. RATIO OF LIFT TO DRAG IN RECTANGULAR FLAT PLATES OF VARIOUS ASPECT RATIOS

TABLE 4

DISTANCE OF CENTER OF PRESSURE FROM LEADING EDGE, MEASURED IN TERMS OF CHORD FOR RECTANGULAR FLAT PLATES OF VARIOUS ASPECT RATIOS

A R = 1		A R = 3		A R = 6		A R = 1/3		A R = 1/6	
Dist.	Angle	Dist.	Angle	Dist.	Angle	Dist.	Angle	Dist.	Angle
.12	8	.273	3.0	.207	0	.167	3.0	.280	2.7
.14	1.0	.267	7.8	.300	8.0	.267	5.0	.311	7.4
.18	2.0	.300	10.0	[illegible]	10.0	.281	6.8	.323	10.7
.20	2.8	.333	12.0	.367	12.2	.300	10.8	.334	19.0
.22	1.8	.367	11.8	.400	20.0	.317	17.5	.345	43.0
.24	6.7	.400	17.7	.433	74.0	.334	36.5	.350	52.0
.28	13.0	.433	72.8	.467	77.7	.370	45.0	.367	51.4
.30	17.1	.467	77.7	.500	90.0	.387	47.8	.378	70.2
.32	18.0	.500	90.0			.381	70.2	.389	78.0
.34	21.0					.400	72.7	.400	79.7
.36	27.0					.417	74.1	.411	80.0
.38	28.0					.433	70.7	.422	83.0
.40	33.7					.450	67.0	.433	84.0
.42	39.0					.467	77.8	.444	88.5
.44	55.2					.483	85.8	.477	72.5
.46	73.5					.500	90.0	.466	80.0
.48	84.0							.477	84.0
								.488	87.7
								.500	90.0

In Fig. 3 are plotted values of K_y against angle of incidence for various aspect ratios. In Fig. 4 the same treatment is applied to the L/D ratio.

In Fig. 5 are tabulated the positions of the center of pressure for various aspect ratios and angles of incidence. In Fig. 6 the directions and points of application of the resultant forces are indicated for a flat plate of aspect ratio 6—the value which is usually employed for purposes of comparison—in order to give the reader a more graphic idea of the forces at play.

In all these values it may be noted that no allowance is made for possible variation in the coefficients with size of plates, and this is probably accurate enough for all practical purposes.

Preliminary Application of Data for Flat Plates in Rudder and Elevator Design

These curves and tables give fairly complete data for flat plates and are likely to meet all the requirements of design. It may be useful to indicate a few salient points, and to make preliminary reference to the design of flat rudders and elevators.

(1) For plates of all aspect ratios when turned from zero angle, the lift increases until the critical angle or "burble point" is reached. Beyond this angle the lift rapidly decreases, and no rudder or elevator should be employed beyond this critical angle.

(2) The lift drag ratio is not much improved, for flat plates at the same angles, by increased aspect ratio. For all plates

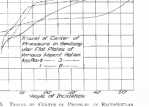

FIG. 5. TRAVEL OF CENTER OF PRESSURE IN RECTANGULAR FLAT PLATES OF VARIOUS ASPECT RATIOS

the ratio reaches its maximum value at small angles, 6° or 7°. At angles still smaller it decreases, due to the predominating effect of the skin friction. Plates of large aspect ratio, being more sensitive at small angles, are, on the whole, more efficient in flight.

(3) On the other hand, plates of small aspect ratio have the critical angle much later and give a wider range of action. They also give a much higher lift at the critical angle, which is important in the action of the rudder when "taxiing" at low speeds on the ground.

(4) For the elevator, which is more constantly used in the air, and from which great lifting power is not required on the ground, an aspect ratio of three seems a fair compromise

(5) For the rudder, the above considerations seem to indicate an aspect ratio of one or two as advisable

(6) It should be noted that, as the angle of incidence is increased, not only does the force increase, but also that from

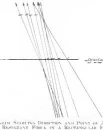

FIG. 6 DIAGRAM SHOWING DIRECTION AND POINT OF APPLICATION OF RESULTANT FORCE IN A RECTANGULAR FLAT PLATE OF ASPECT RATIO 6 AT SMALL ANGLES OF INCIDENCE

the point of application of the resultant force to the hinge, giving a greatly increased moment about the hinge If either the elevator or the rudder is placed too near the wings it necessitates large areas for the controlling surfaces, and the pilot may have to exert tremendous force at large angles

(7) To obviate the necessity of exercising large forces on the controls, it is possible to use a balanced rudder, one in which the hinge is placed about in the position of the center of pressure at small angles The rudder in Fig 7 is a balanced rudder It should be noted that the "balance" is only approximate

Problems on Flat Plates

A rectangular flat plate 4 feet 9 inches high and 3 feet 2 inches long is employed as a rudder, and is placed with its leading edge at a distance of 18 feet from the center of grav-

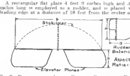

FIG 7 DIAGRAMS FOR ASPECT RATIO IN RUDDER AND ELEVATOR

ity of the machine The machine is traveling at 60 miles an hour The rudder is hinged at the leading edge, while the control leads are one foot from the rudder surface (See Fig 8) Find (a) the frictional resistance of the rudder when neutral, (b) its turning moment about the center of gravity when set at an angle of 10° and its resistance at that angle, (c) the tension in the control lead under the same conditions as (b)

(a) The area of the rudder = $3\frac{1}{6} \times 4\frac{3}{4}$ = 15 square feet From Fig 13 in Section 3, we see that the frictional resistance on a surface of 15 square feet at 60 miles an hour equals .0285 pounds per square foot. Thus the total frictional resistance = 15 x .0285 = .431 pounds

(b) The aspect ratio of the rudder = 1.5 The distance from the leading edge to the center of pressure is given by Fig. 5 Interpolating between (A R = 1) and (A R = 3), we see that the center of pressure on a plate of aspect ratio 1.5 at an angle of incidence of 10 is .268 of the chord from the leading edge Thus the desired distance = $3\frac{1}{6}$ x .268 = .85 ft.

The moment arm about the center of gravity longitudinally (see sketch of machine) = 18 + .85 cos 10° = 18.84 feet.

The moment arm about the center of gravity laterally = .85 sin 10 = .14 feet

By Figs. 3 and 4, K_y = .00109 and L/D = 5.5 Then L, the force perpendicular to the line of flight, = $K_y AV^2$ = .00109 x 15 x (60)² = 58.9 pounds, and D, the resistance = $L \div L/D$ = $\frac{58.9}{5.5}$ = 10.8 pounds It will be seen that turning the rudder causes a decided increase in the resistance of the machine.

The above work gives us a basis for rapidly computing the turning moment M = 58.9 x 18.84 + 10.8 x .14 = 1112 pound feet taking the moments of both the lift and the drag about the center of gravity.

(c) The turning moment about the leading edge of the rudder = 58.9 x .85 cos 10° + 10.8 x .85 sin 10° = 51 pound feet

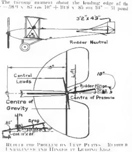

FIG. 8 RUDDER FOR PROBLEM ON FLAT PLATES RUDDER IS UNBALANCED AND HINGED AT LEADING EDGE

Moment arm of control lead = cos 10 = .986 foot

Then, since the stress in the control lead times the moment arm must just balance the turning moment of the rudder about its axis, tension in lead = $\frac{51}{.986}$ = 76.3 pounds

General Considerations of Sustaining Power and Resistance of Wing Sections

We have seen that the equation for lift is

$$L = K_y A V^2 \qquad (1)$$

where K_y is a constant varying with the angle of incidence, A = area in square feet, and V = speed in miles per hour

In horizontal flight, the lift equals the weight of the machine, W, and the equation becomes

$$W = K_y A V^2 \qquad (2)$$

which can be expressed in the forms

$$K_y = \frac{W}{AV^2} \qquad (3)$$

$$V = \sqrt{\frac{W}{K_y A}} \qquad (4)$$

$$A = \frac{W}{K_y V^2} \qquad (5)$$

as may be convenient. The lift coefficient is small at small angles and increases at larger angles until the "burble" point

or critical angle is reached, as can be seen from the curve of a standard wing section (R A F 6) in Fig 9

From these considerations may be deduced the following ideas, which should become absolutely familiar to every student of aeronautics.

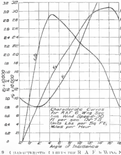

FIG. 9 CHARACTERISTIC CURVES FOR R A F 6 WING SECTION

A machine traveling fast will require by equation (3), a small value of K_y, and hence a small angle of incidence Conversely, flying slowly it will require a large angle of incidence

Sustaining a given weight, we can vary angle of incidence and either area or speed

If we give a machine a large wing area, it will fly slowly With a small area, it will attain a high velocity if sufficient engine power is available

The drag equation is

$$D = K_x AV^2 \qquad (6)$$

The higher the value of L/D, the smaller will be the drag for a given lift and weight of machine at a given speed, and the less will be the power required The ratio L/D is therefore a measure of the wing efficiency For the R A F 6, the maximum value of L/D is at about 4° and at about this angle a machine would fly at its greatest efficiency

We have here neglected all other resistances than those of the wings These resistances will modify the drag equation and the best angle of flight. We shall deal with these modifications under the Economic Laws of Flight.

Problem of Sustentation and Resistance of Wing Surface

A monoplane weighing 2000 pounds uses an R A F 6 wing section

(a) What area will it require so that its lowest speed may be 45 miles an hour?

(b) What will be the drag of the wing at this speed and what will be the horse-power required for the wing alone?

(c) Assuming that the parasite resistance (resistance of the body, chassis, wires, struts, etc) is 120 pounds at 60 miles an hour, and that it varies directly as the square of the speed, what will be the total resistance and horse-power required at this speed?

(d) If the power delivered at the propeller is 100 horse-power, what is the maximum speed available?

(a) Let A = wing area
W = weight of machine
D = drag of wing
P = parasite resistance
R = total resistance = $D + P$

From Fig. 9 we see that the maximum value of K_y is .00309, at 16°. Then, since $W = K_y AV^2$, and V = 45 miles per hour,

$$A = \frac{W}{K_y V^2} = \frac{2000}{.00309 \times (45)^2} = 319 \text{ square feet}$$

(b) From Fig. 9, L/D at 16 = 6.8 Then $D = \frac{2000}{6.8}$ = 294 pounds.

Since $\frac{1}{375}$ horse-power is required to overcome a resistance of 1 pound at 1 mile per hour, horse-power = $\frac{DV}{375} = \frac{294 \times 45}{375}$ = 35.3 horse-power to overcome wing drag at 45 miles per hour.

The drag of the wings can also be obtained, of course, by substituting the proper value of K_x in the equation

$$D = K_x AV^2$$

The first method described will prove the simpler when a number of cases are to be worked out, but the second is more accurate at very small angles of incidence

(c) At 60 miles an hour $K_y = \frac{W}{AV^2} = \frac{2000}{319 \times (60)^2}$ = .00174.

Fig 9 shows us that this value of K_y will be attained at an angle of incidence of 5.7°, at which angle L/D = 14.2.

Then $D = \frac{2000}{14.2}$ = 141 pounds, and $R = D + P$ = 141 + 120 = 261 pounds

The power required equals $\frac{RV}{375} = \frac{261 \times 60}{375}$ = 41.8 horse-power

(d) In order to determine accurately the speed obtainable with a given power, it is necessary to plot a curve of power required at various speeds In computing points on this curve, we assume the parasite resistance proportional to V^2. This is approximately true, the deviation being due to changes in resistance coefficients of body, struts, etc , as the angle at which they meet the wind changes. Proceeding on this assumption, $P = KV^2$, since P = 120 pounds when V = 60 miles per hour, $K = \frac{P}{V^2}$ = .0333, and P = .0333V^2.

In Table 5 are given a few points on such a curve, computed as was that for 60 miles an hour, which we just secured. A student might carry through some of these computations, checking his results against those here given, in order to make sure that the method is perfectly clear to him.

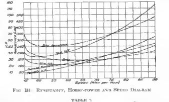

FIG 10 RESISTANCE, HORSE-POWER AND SPEED DIAGRAM

TABLE 5

V	K_y	Angle of inc	K_x	L/D	D	P	R	Wing H P	Parasite H P	Total H P
45	.00309	16.0	.000449	6.9	289	97	359	34.8	8.0	42.8
50	.00251	9.9	.000218	11.5	174	83	257	23.2	11.1	34.3
55	.00207	7.4	.000156	13.3	150	101	251	22.1	14.8	36.9
60	.00174	5.9	.000122	14.3	140	120	260	22.4	19.2	41.6
65	.00148	4.4	.000102	14.5	138	141	278	24.0	24.4	48.4
70	.00128	3.5	.000093	13.8	145	163	308	27.1	30.4	57.5
75	.00111	2.9	.000087	12.8	156	187	343	31.2	37.4	68.6
80	.00098	2.2	.000082	11.9	168	213	381	35.7	45.5	81.2
85	.00087	1.8	.000081	10.7	187	241	428	42.5	54.6	97.1
90	.00077	1.3	.000081	9.8	211	270	481	50.6	64.8	115.4

These curves having been plotted, the maximum speed can be obtained by noting the point at which the curve of horsepower required intersects the 100 horse-power line. This is at 85.7 miles per hour, which is therefore the greatest speed attainable by this machine.

References to Section 4

CONTROVERSIAL ASPECTS OF VALUES OF COEFFICIENTS FOR FLAT PLATES OF VARYING SIZES

Notes on the Dimensional Theory of Wind Tunnel Experiments. E. Buckingham. Reports on Wind Tunnel Experiments in Aerodynamics. Smithsonian Miscellaneous Collections.

Critical Speeds for Flat Disks in a Normal Wind. J. C. Hunsaker and E. B. Wilson. loc. cit.

Bulletin de l'Institut de Koutchino. Moscow. 1912.

DATA FOR R. A. F. 6 WING SECTION

The Resistance of Air and Aviation. G. Eiffel, translated by J. C. Hunsaker.

DATA FOR R. A. F. 8 WING SECTION

Reports on Tests of Four Aerofoils. Report of the British Advisory Committee on Aeronautics 1912-1913. Report No. 72.

A Low Priced Sporting Dirigible

Inquiry has been made regarding the sportsman's dirigible that was mentioned in the August 1 issue of AVIATION. This machine, which has been suggested by Samuel L. Collins, M.Ae.S., A.M.I.A.E., was described in a recent issue of *Flight* and the estimated cost of construction was placed at the low figure of from £2,500 to £3,000. While this dirigible is of simple design, opinion has been expressed that if manufactured under American conditions, the cost would exceed this estimated European value, and that the European value itself is far too low.

GONDOLA OF A SPORTING TWO-SEATER DIRIGIBLE.

Mr. Collins has prepared drawings for a vessel about 150 feet long and 45 feet high, the housing of which will not offer insuperable difficulties. The shape of the hull is somewhat on the lines of that known as B. F. 36, a shape which experiments carried out at the N. P. L. have shown to be one giving excellent results regarding head resistance, speed, etc.

The gondola containing the pilot, passenger and power plant has been designed much on the lines of a *nacelle* of a pusher biplane, the propeller being located at the extreme rear. Such an arrangement makes for a very simple and compact disposition of the "business" components—propeller, engine, fuel tanks, control gear, etc. The problem of suspending the gondola from the envelope is one that requires some careful thought in order that the stresses shall be evenly distributed and the propeller given freedom of action.

The gondola consists of a rectangular fuselage built up of four longitudinals, with necessary cross members, all thoroughly wire braced, the stream line shape being obtained by means of formers and stringers, as in aeroplane construction. The covering could either be of thin plywood or of sheet metal such as aluminum.

The landing chassis can consist of two skids connected to the gondola by two pairs of V-struts each, or a modification of this arrangement could be employed in the form of one long skid suitably attached to the gondola. The two seats are arranged in tandem fashion in the fore part of the gondola and only the heads of the occupants project outside.

In the center of the gondola in the same plane as the center of gravity are the fuel and water ballast tanks. Behind the fuel tanks is the blower supplying air to the ballonet and the 80 horse-power engine. Provision is made for starting the engine from the rear cockpit by means of a crank handle and shaft.

The control is extremely simple, consisting of a wheel located at the pilot's right hand for operating the elevators, and a foot rudder bar similar to that used on aeroplanes. Dual control can be fitted if desired. The stabilizing planes consist of four surfaces, each of 120 square feet area, mounted on the tail of the envelope, two mounted horizontally and two just slightly out of the vertical. In place of the latter a vertical surface of 240 square feet area could be fitted. To the trailing edges of these surfaces are hinged the elevators and rudders, each of which has an area of 20 square feet. The author states that a dirigible on these lines would have a cruising range at full power of about eight hours, and a calculated speed of 45 to 50 miles per hour.

The construction of an easily controlled and simple airship of this type would, no doubt, be of interest to American sportsmen, though its production would probably require long and expensive experimentation.

Book Reviews

AEROPLANE DESIGN

By F. S. Barnwell

and

A Simple Explanation of Inherent Stability

By W. H. Sayers

(McBride, Nast & Co., London. Pp. 102.)

The first part of the book, dealing with aeroplane design, is a reprint of a paper read before the Engineering Society of Glasgow University. The aerodynamical data presented is sound, as is a definite plan of preliminary design. The simple but fundamental ideas of lift coefficients, corrections for biplane effects, surfaces required for a certain weight, choice of aerofoils, design of tail surfaces, etc., are plainly stated and supported by excellent diagrams. Several useful tables are given as suggestions for procedure in design. Mr. Sayers' explanation of inherent stability is ingenious.

AIR-SCREWS

By M. A. S. Riach

(D. Appleton & Co. Price $1.75. Pp. 126.)

This treatise deals with the subject of propeller design from a distinctly novel standpoint. The author has carefully explained each step of the mathematical work, so that the book can be read with comparative rapidity by any one who has a slight acquaintance with the subject. The descriptions of the various blade types and the explanations of their respective advantages and disadvantages are exceedingly interesting.

There is a novel and logical discussion of blade interference and the rather complex problem of the helicopter is given a clear exposition. Efficiency at different speeds also is fully treated. The book contains two appendices on the little understood matters of aspect ratio in propellers and the effect of indraught.

Aeronautical Patents

(Copies of these patents may be obtained for five cents each, by addressing the Commissioner of Patents, Washington, D. C.)

ISSUED AUGUST 29, 1916.

1,195,077. Filed Feb. 18, 1914. To Merrill E. Clark, New York. A stabilizer fin attached to a mast perpendicular to the wing.

1,196,403. Filed April 22, 1916. To Clinton V. Tefft, Abbeyville, N. Y. An aeroplane with wings and fuselage capable of retaining gas to give it buoyancy.

1,196,600. Filed July 17, 1915. To H. A. Shale, Los Angeles, Calif. A combined steering and propeller mechanism to exhaust air from propeller through valves.

ISSUED SEPTEMBER 5, 1916.

1,196,834. Filed Sept. 10, 1915. To Adolph J. M. Zorn, Chatsworth, Ill. A bomb dropper with telescopic attachment for aeroplanes.

1,197,504. Filed Dec. 17, 1915. To Lauri Larsen and Edward Brand, Chicago Heights, Ill. A dirigible propelled by compressed air stored in a tank under gas bag with cylinders on both sides.

1,197,805. Filed May 1, 1916. To Arlington L. Leatart, Los Angeles, Calif. An aeroplane with main planes and rear surfaces having front edges in straight line and rear edges angular forming triangles.

News of the Fortnight

An Aviation Luncheon

The organization of the first flying boat club was celebrated on August 31, when the Harlem Board of Commerce tendered a luncheon to the members of the New York Flying Yacht Club, at which several of the guests arrived from long distances in their flying boats.

Aside from the spectacular arrival and leave-taking by the guests, interest centered in the announcement that $40,000 had been subscribed for the erection of a club house for the new organization, which will be the first station to be established in a patrol that is to include all the coasts of the United States.

The first to arrive was Beryl H. Kendrick, who, with his mechanic, J. D. Davis, left Atlantic City at 8.30 A. M., and arrived at the Flying Yacht Club station, 129th Street and the Hudson River, at 10.30. They made the trip at an average of sixty-nine miles an hour, and would have arrived earlier, but they got lost in a fog, from which they emerged to find that they had mistaken Staten Island for Coney Island.

Photo by Paul Thompson

THEY FLEW TO THE LUNCHEON

From left to right: Beryl H. Kendrick, Robert Edgren, David McCullough, Frank Coffyn, Lawrence Sperry and Ripley Bowman

Lawrence B. Sperry, with Ripley Bowman as passenger, was the second to arrive. He left Amityville, L. I., at 12:02, and, circling over Coney Island and Fort Hamilton, came by the Battery and up the river, making his landing shortly before 1 o'clock.

TEN MINUTES FROM LONG ISLAND

David McCullough came in exactly ten minutes from Port Washington, L. I. With him was Robert Edgren as a passenger.

Thomas P. Fowler, president of the Harlem Board of Trade, was toastmaster at the luncheon, at which were Rear-Admiral Robert E. Peary, Alan R. Hawley, president of the Aero Club of America; F. T. Davison, captain of the First Squadron of the New York Aerial Coast Patrol; Edward M. Hagar, president of the Wright-Martin Aeroplane Company; Louis H. Fehr, secretary of the Park Board; and several others spoke.

In his address Rear-Admiral Peary made a plea for a department of aeronautics whose chief should have a seat in the President's Cabinet. He said:

"The line of defense in which the United States is not merely woefully deficient, but is absolutely lacking, is air defense. We need a broad, comprehensive, centralized system, planned on a large scale to meet the certain developments of the near future, and we need not tens, not hundreds, but thousands of aviators. We should have an aviation class as numerous as our present chauffeur class."

Following the luncheon, the guests were taken to the Harlem River in automobiles, the great crowds waiting for the flying flights. There Mr. Sperry took up Rear-Admiral Peary and demonstrated the effectiveness of his stabilizer, and later Mr. Kendrick and Mr. McCulloch gave an exhibition race up and down the river, showing something of what the annual Manhattan Derby is to be like. Then Mr. McCulloch took Rear-Admiral Peary as a passenger to Governor's Island, and Mr. Kendrick took Lieutenant J. Homer Stover to Sea Girt, N. J.

To Organize an Aero Club of Hawaii

Active steps toward the organization of an Aero Club of Hawaii will be taken in a short time by Brig.-Gen. R. K. Evans, commanding officer of the Hawaiian department. The military necessity for such a club in the islands is clear from the fact that the defense plans of Oahu call for an aero squadron. He will soon call on the professional and business men of Honolulu and vicinity who are interested in aviation, and will outline his plans to them, and confer as to the most practical method of procedure to follow in organizing the local club, which will be affiliated ultimately with the Aero Club of America. General Evans is a member of the military and naval aviation committee of the Aero Club of America.

Pensacola News

Over one hundred commissioned officers will compose the school of instruction at the Pensacola aviation station within the next few months, while aeroplanes, and possibly dirigible balloons, will be manufactured. Capt. H. C. Mustin, commander of the station, has received instruction from Washington to begin immediate preparations for the manufacture of aeroplanes and machinery, and other special equipment required for this work will be received shortly.

New concrete hangars are in course of construction, while the big brick wall on the east side of the yard is to be demolished and the station extended to take in all of the territory formerly occupied by the town of Woolsey. Concrete piers also are to be erected for use of war vessels sent here to practice with the fliers and other work done on buildings that will call for the employment of a large force of men.

Navy Bids Opened

Bids for thirty hydroaeroplanes, to be used for training recruits at the naval aviation school at Pensacola, Fla., were opened on September 5 in Washington. Eight companies submitted bids.

The prices were as follows:

Number of Machines	Planes Low	Planes High	Motors Low	Motors High	Complete Planes Low	Complete Planes High
1	$4,000	$10,100	$5,000	$4,860	$8,800	$12,320
[illegible]	4,750	10,000	3,000	4,910	8,090	12,320
8	4,550	10,000	3,000	4,910	7,750	12,120
12	4,270	10,000	3,000	4,910	7,250	11,920

It is not unlikely the contracts will be distributed among several concerns, regardless of the price, the object being to get the planes quickly and also to develop aeroplane factories. The hydroaeroplanes sought are for training school work entirely, but as they must be able to attain a speed of seventy miles an hour, they are about equal to standard war planes in all essentials except endurance.

Ordered to the Border

Under orders to proceed to Columbus, N. M., to join the First Aero Squadron, six junior military aviators, who recently completed their training at North Island, are preparing to go to their new posts. C. V. Knight, inventor of the Knight sleeve valve motor, recently addressed the detachment at North Island on the development of the gas engine.

The aviators who are to leave are Lieutenants Lee G. Heffernan, Fifth Cavalry; George Brett, Second Cavalry; George Reinburg, Seventh Cavalry; John McDonnell, Eleventh Cavalry; John Davis, Third Cavalry, and Sheldon Wheeler of the Twenty-fifth Infantry.

A Wireless Feat

Capt. C. C. Culver, attached to the United States signal corps training school at North Island, in an army machine, on September 1, received a wireless message which was transmitted a distance of several miles from another machine carrying Lieut. W. A. Robertson. According to Captain Culver, this is the first time on record in this country, and perhaps in the world, that a wireless message has been received by one aeroplane from another while both machines were in flight. The other machine was operated by A. D. Smith.

Third and Fourth Aero Squadrons

Preliminary plans have been made toward organization of the third aero squadron at San Antonio, Tex. The new unit will be known as the Third squadron and will be commanded by Major B. D. Foulois.

The squadron is intended for service in this country and will be equipped with six Curtiss biplanes with twin ninety-horsepower motors. The six planes have been ordered but only one has been received by the government and given practice trials. The other five are expected in a few days.

Fort Sam Houston was designated as an aero station several months ago when the first squadron was ordered there from Fort Sill, Okla. Major Foulois, then a captain, was in command of the squadron and made a flight from the Fort Sill station to Fort Sam Houston.

Following the organization of this squadron, the fourth one will be organized. Probably it will be equipped with battle aeroplanes armed with one machine rifle and two Winchester automatic shoulder rifles. On the basis of plans made for furnishing reserve machines, 24 more of the battle aeroplanes will be required for the squadron.

DIRIGIBLE SQUADRON

Plans also have been made for the organization of Fort Fort Sill, Okla. Major Foulois, then a captain, was in com- balloons as soon as the balloons can be obtained. Four balloons will be required for this organization and it is not expected that much delay will be met in obtaining them. The organization will include about 4 commissioned officers and 80 enlisted men. The training in captive balloon work will be valuable in giving preliminary qualifications for operation of dirigible balloons. The army aviation authorities are co-operating with those of the navy toward the ultimate production in this country of satisfactory dirigibles.

Massachusetts Naval Reserve Aviators to Camp

From September 10 to September 30 is the time set for the first tour of duty of Massachusetts naval aviators. The location has not been definitely decided as yet, but it is believed that the camp will be on Misery Island, off Beverly. Capt. William B. Edgar is in charge of the arrangements.

Thirty-five men, including flyers, officers, cooks and mechanics, will attend the encampment, the flyers being drawn from the Marblehead and Newburyport deck divisions of the Naval Militia. Norman E. Merrill of Walpole, Norman Cabot and Clifford Webster, the professional flyer, will be among those at camp. Of the 35 men who will attend, only 10 will fly, the rest being necessary for auxiliary duty.

The probable spot for the beaching of the machines lies between Great and Little Misery Islands, and is protected from every wind but that from the northwest. Above the beach is a large meadow, which makes an ideal spot for a camping ground. A canvas hangar has been ordered by the War Department for the use of the militiamen, but the date of its arrival is not certain. It will house one of the three machines which will be used by the militiamen. Godfrey Cabot, one of the prime movers for the aero squads, is building a concrete hangar for his own machine.

Good Work Recognized

Recognition of his work in the aviation section of the Signal Corps, U. S. A., since the punitive expedition began, has come from the Government to Lieutenant E. S. Gorrell, who made a record breaking cross-country flight with Lieutenant H. A. Dargue, in the detail for a course in aeronautical engineering at the Massachusetts Institute of Technology. This will make of the young officer, who is a West Pointer, an expert in matters concerning aviation, he having already a large amount of practical experience here under Major Benjamin Foulois.

Aeroplanes to Aid Explorers

Aeroplanes are to be included in the equipment of an exploring expedition that is setting out from Buenos Aires to study a little known region, which includes Mar Chiquita, a lake having an area of some 1,000 square miles, located about 350 miles northwest of that city. It is the belief of the explorers that with aeroplanes it will be possible to secure panoramic photographs which will prove invaluable in showing the topography and geography of the country.

Civil Service Examination for Aeronautical Draftsman

The United States Civil Service Commission announces an open competitive examination for aeronautical mechanical draftsman for men only. From the register of eligibles resulting from this examination certification will be made to fill four vacancies in this position, two at $1,800 and one at $1,200 per annum in the Office of the Chief Signal Officer, War Department, Washington, D. C., and one in the Signal Corps Aviation School at San Diego, Calif., at $1,200 per annum, and vacancies as they may occur in positions requiring similar qualifications, unless it is found to be in the interest of the service to fill any vacancy by reinstatement, transfer or promotion.

In filling vacancies in positions with headquarters outside of Washington, D. C., certification will be made of the highest eligibles residing in the vicinity of the place at which the vacancy occurs except that upon the request of the department certification be made of the highest eligibles on the register for the entire country who have expressed willingness to accept appointments where the vacancy exists.

Competitors will not be assembled for examination, but will be rated on the following subjects, which will have the relative weights indicated:

SUBJECTS

Subjects	Weights
1. General education	25
2. Technical training and experience	60
3. Practical tests rated on work submitted	15
Total	100

Applicants will be required to submit with their applications one specimen of pencil drawing (mechanical) and a tracing thereof executed by them, with a statement that the drawings submitted are wholly the work of the applicant. These drawings are to be 14 by 17 inches and should be such as to show clearly the applicant's ability in drawing and lettering. Drawings must include at least five circles ½ inch in diameter, also some irregular curve work including sharp reverses with small radii. These may be submitted as a separate sheet in addition to any other drawings of the competitor's choosing. The applicant's name should be lettered or written on each.

At least one and one-half years' experience in design, including not only mechanical drawing but also strength calculations either in an aeroplane or automobile factory, is a prerequisite for consideration for this position. Special credit will be given to mechanical engineering graduates with considerable practical experience in the above lines of design.

Statements as to education, training, and experience are accepted subject to verification.

Age 20 years or over on the date of the examination.

Applicants will be admitted to this examination regardless of their residence and domicile; but under act of Congress only those who have been actually domiciled in the State or Territory in which they reside for at least one year previous to the date of the examination will be eligible for appointment to a position in the apportioned service in Washington, D. C. Persons desiring to become eligible for appointment to the apportioned service must have the county officer's certificate in the application form executed, to which a ten-cent internal revenue stamp must be attached.

This examination is open to all men who are citizens of the United States and who meet the requirements.

Persons who meet the requirements and desire this examination should at once apply for Form 1312, stating the title of the examination desired, to the United States Civil Service Commission, Washington, D. C.; the Secretary of the United States Civil Service Board, Post Office, Boston, Mass.; Philadelphia, Pa.; Atlanta, Ga.; Cincinnati, Ohio; Chicago, Ill.; St. Paul, Minn.; Seattle, Wash.; San Francisco, Calif.; Customhouse, New York, N. Y.; New Orleans, La.; Honolulu, Hawaii; Old Customhouse, St. Louis, Mo.; Administration Building, Balboa Heights, Canal Zone; or to the Chairman of the Porto Rican Civil Service Commission, San Juan, P. R. Applications should be properly executed, excluding the medical certificate, and must be filed with the Commission at Washington with the material required, prior to the hour of closing business on September 26, 1916. The exact title of the examination, "United States Civil Service Examination, Aeronautical Mechanical Draftsman (Male), September 26, 1916," should be stated in the application form.

International Air Rules

The Canadian Government has issued an order which will prohibit American aviators from flying over the boundary. This was due to flights made over Niagara Falls, and Windsor, Ont.

Monterey Camp Ends

Bringing with them two aeroplanes which they constructed at the recent encampment at Monterey, and which, with a few extra touches, will be ready for service, the aviation section of the Monterey Citizens' Training Camp returned on September 11.

With Major Earle Remington, president of the Aeronautical Society of California, in charge, the 84 Los Angeles men made an enviable record at the big camp. With Company "B" of Berkeley, the Southerners, Company "A," constitute the first volunteer aero squadron in the United States War Department.

"The boys were taught a lot by Major Remington, Capt. Harold Geiger, U. S. A., and Capt. LeRoy Muller, U. S. A.," declared Chas. F. O'Brien, vice president of the Aeronautical Society. "Under Capt. 'Ted' Ford, Company 'A' is planning big things for the near future." The entire expense of the delegation was borne by the Aeronautical Society.

Rockwell Gets Fourth Enemy Aviator

The morning official report of September 11 from Paris describing the forty air battles of the previous Saturday, ends, "another enemy aviator was downed within the first German lines near Vauquois." This was the fourth officially recorded victory of Kiffin Rockwell, the American aviator with the French army. The next will put him in the class whose names are quoted officially.

Rockwell was flying alone in his machine over the Verdun sector when he sighted a two-seated German aeroplane. He attacked it at an elevation of 3,750 feet, killing the German gunner with the first volley of his machine gun, and probably hit the pilot, who tried to reach land. Rockwell followed the German machine down to within 6,000 feet from the ground, keeping up his fire.

Two German aeroplanes then came to their comrade's rescue and attacked Rockwell from above, putting him in a very dangerous position. Seeing that his first adversary was well finished Rockwell turned on the two others and fired all his remaining cartridges. He got away safely, though his machine was hit many times. The first German fell right in the enemy first line trenches, plainly visible to a French battery which quickly smashed it to fragments.

Alaska Mail by Aeroplane

Congressman Murray Hulbert of New York announced, on September 2 that the Post Office Department soon is to establish its first aeroplane mail delivery route. The mail is to be transported by aeroplane between Seward and Nome, Alaska, according to Mr. Hulbert, with Iditarod as a distributing center for inland deliveries.

He says the Post Office Department has received an acceptable bid from Earl L. Byers for the delivery of mail by aeroplane in Alaska, and that a semi-weekly service is to be furnished. The reduced cost of such delivery, he says, will amount to $34,538 per annum.

"Many days will be saved by the aeroplane deliveries," said Mr. Hulbert. "The time of transit of mail in winter from Cordova to Fairbanks to Nome is approximately thirty days. The time from Seward to Iditarod (aeroplane) and Kaltag to Nome will be about eighteen days, thus saving considerable time in the interior deliveries. From Iditarod the mails will be sent by dog sleds to other interior points."

The following statement was issued by Assistant Postmaster Praeger:

ALASKA, ROUTE NO. 678013.

From Seward by Knik, Susitna, McGrath, Takotna and Flat to Iditarod.

Frequency twice a week all the year. Weight limit 1,000 pounds.

The only bid received May 13, 1916 in response to the aeroplane advertisement of February 12, 1916, was the following bid for route 678013 Seward to Iditarod:

Earl L. Byers $40.50 No bond.

This bid is at the rate of 64½ cents a mile and 23½ cents a pound on the basis of the full weight limit being carried both ways every trip.

The rate for the present winter service (November 1 to April 30) on the Seward-Iditarod route is $22,865 for the period of

each year, \$21 cents a mile and 02.5 a pound. The length of the aeroplane route, however, is stated as 480 miles (air line), whereas the star route between the same points by trail is 528 miles.

Were the aeroplane route established, it is estimated that the present service could be changed as follows:

Reductions	
Seward-Iditarod route (discontinue)	\$22,865
Cordova to Fairbanks route (reduce)	10,651
Fairbanks to Tanana route (reduce)	9,250
Tanana to St. Michael route (discontinue)	35,000
Holy Cross to Iditarod route (discontinue)	6,715
Tanana to Unalakleet route (omit)	1,200
Susitna to Kalt route (discontinue)	485
Ophir to McGrath route (discontinue)	320
Total saving	\$106,466
Increases	
Seward to Iditarod (aeroplane)	\$48,000
Iditarod by Kaltag to Nulato	12,800
Kaltag by Unalakleet to St. Michael	7,200
Tanana to Ruby	2,048
Ruby to Yukokakat	280
Total increases	\$71,908
Reductions	\$106,466
Increases	71,908
Net saving to the department	\$34,558

The time of transit of mail in winter from Cordova by Fairbanks to Nome is approximately 30 days.

The time from Seward by Iditarod (aeroplane) and Kaltag to Nome would be about 18 days.

Mail to Gen. Pershing by Aeroplane

Columbus, New Mex., now boasts an aeroplane rural delivery, if Mexican headquarters of the punitive expedition can be called rural in the postal sense. The Columbus post office is rather unique in the prominence into which it sprang over night, when from being barely more than fourth class in importance it jumped to the handling of mail of the most vital interests to army movements.

The cream of the mail, official usually in character, is taken by air route, early in the day, and similar mail brought back to the base. It would be interesting if Uncle Sam added the daring aviators of the First Aero Squadron to his list of postal employees, and sent them a postal salary. Surely no employee in all the Government is giving more danger defying service, in the line of duty than these lieutenant mail carriers of the army.

Thomas Company to Try Mail Carrying

The Thomas Aeroplane Company, of Ithaca, wants to experiment in carrying mail and has asked the Post Office authorities at Washington for a permit to establish a mail route between Ithaca and the Fair Grounds.

Sues for Aeroplane Accident

To recover damages for the death of her husband, who was killed while testing an aeroplane last year, Mrs. Naomi Gessner has entered suit against the Boughton Flying Machine Company, of 4424 Larchwood avenue, Philadelphia. At the time the accident occurred Gessner was employed by the company. Suit was entered against Frank Boughton several months ago and this last suit is merely to change the name of the defendant to the company.

The M. F. P. Steel Aeroplane Equipped with a 125 Horsepower Hall-Scott Motor

New Aeroplane Companies

During August the following large companies are reported to have incorporated with a total combined capital of \$1,505,000.

	Capital
Aero Ordnance Corp., arms, aeroplanes, New York	\$600,000
National Aircraft Corp., New York	100,000
The International Aircraft Co., Illinois	300,000
The Brooks Aircraft Co., Illinois	50,000
The U. S. Aeromobile Co., manufacturing aeroplanes, New York	105,000
Tech Company, manufacturing flying machines, etc.	250,000
American Aeroplane Co., New York	100,000

Among other recent incorporations are:

The National Seamless Boat Company, of Newark, was incorporated in Trenton, N. J., with a capital of \$500,000. It is to design, build and deal in hydroplanes, aeroplanes, submersibles and all kinds of craft.

Pyro Ignition Co., Inc., New York. To manufacture spark plugs for autos, aeroplanes, engines, etc. Capital, \$50,000. Incorporators: C. R. Allison, W. I. Glover, P. C. Pinner, 115 Broadway.

Automobile Crankshaft Co., Inc. To manufacture autos, aeroplanes, tractors, parts and devices. Capital, \$1,000,000. Incorporators: W. E. Roche, A. B. and J. M. Hibbard, 192 Piquette Av., Detroit, Mich.

Grant's Tomb as Photographed from Lawrence Sperry's Hydroaeroplane

Curtiss Land and Water Machine Tested

Pilot Victor Carlstrom, accompanied by one of the navy aviators, on Aug. 23, piloted the Curtiss J N twin motor combination land and water biplane on a successful four-hour endurance flight at Newport News.

The machine, which is equipped with dual controls, the Curtiss and Dep systems being used, was piloted by Carlstrom, then by the navy officers. It was equipped with pontoons on the flight and went up as an hydro-aeroplane. The course was a circular one, the extreme ends being below Old Point Comfort and a point some distance north of the shipbuilding plant at Newport News.

Order for Orlo Engines

Twenty engines, to be installed in hydro-aeroplanes at Pensacola, Fla., are reported to have been purchased from the Orlo Motor Company, Rochester, N. Y., by the United States for the navy. The motors which sell at \$3,750 each were invented by Orlo Welles, president of the company. They are light and compact, and with propeller, radiator, water and gasoline, weigh only 600 pounds each.

Mr. Welles has under construction a biplane-type hydroaeroplane.

Otis C. Funderburk, of Springfield, Ill., has designed and constructed a very fast hydroplane, and the German government is said to have offered him \$50,000 for boat patents which he has secured. This offer was rejected.

Harry Witts and A. Croft have established an aviation camp at Bay Shore, Long Island. They are conducting a school as well as a ferry across Great South Bay.

IT IS REPORTED THAT—

FREDERICK T. DAVISON and his instructor, DAVID H. MCCULLOUGH, while engaged on September 8 in conjunction with the "mosquito" fleet of power craft, in the work of perfecting the new naval defence system for New York Harbor, were caught twenty-five miles outside the harbor entrance in a sudden blow that preceded a thunderstorm and narrowly escaped with their lives. At an altitude of 2,100 feet the flyers, in a Curtiss flying boat, endeavored to volplane to shelter. After half an hour they were able to alight on the wind lashed surface of the Great South Bay. They were rescued from the water by the Oak Island Life Saving Station. It was Mr. Davison's second escape this week. On Wednesday Mr. Davison and ROBERT A. LOVETT found themselves 1,000 feet above the East River with their aeroplane engine "gone dead." Mr. Davison was successful in piloting his machine to the water in safety, and the couple were rescued in a launch from the steam yacht Viking, owned by Commodore George F. Baker, of the New York Yacht Club.

LAWRENCE B. SPERRY, on September 1, flew his hydroaeroplane, equipped with three searchlights, over the water from Moriches to Amityville, New York, a distance of fifty miles, in an hour and forty-five minutes. The gyroscopic pilot kept the machine on an even keel, and Sperry steered by compass.

CAPTAIN G. F. BLAIR, of Portland, Ore., is organizing an aeroplane corps for the Oregon Naval Militia. L. T. Barin will be in command.

CHARLES D. WYMAN and J. W. STRUTHERS, civilian aviators, both of New York, who are under instruction at the Governors Island School, were badly injured on September 8 when the machine they were flying fell several hundred feet and was wrecked. This is the first serious accident that has occurred in over 800 flights.

KATHERINE STINSON is flying in the East filling many engagements. She will fly at the Virginia State Fair on October 8.

THE INTERNATIONAL AEROPLANE COMPANY, INC., 27 William Street, New York, has acquired fifty acres near Plainfield, N. J., to be used for its factory and aviation field.

N. J. NELSON, of New Britain, Conn., offered his services to the postmaster at Hartford as a mail carrier in case of a strike on the railroads. He agreed to carry 150 pounds of mail each trip.

LIEUT. WARREN G. CHILD, U. S. N., while flying on September 8 up the Potomac, near Washington, was slightly injured when his hydroaeroplane fell and was badly damaged.

BRIG. GEN. ROBERT K. EVANS has requested the War Department to furnish him 24 aeroplanes for service in Hawaiian territory.

A. K. LONGREN, of Topeka, in testing his new tractor, punctured a tire and his machine turned over. Only the propeller was broken.

HAMILTON COOLIDGE, of the Harvard squad at the Curtiss School, has qualified for his license. Students at this school are now daily taking their "solo" flights for the pilot's license. All of the Harvard squad are ready and anxious to make their trials. Coolidge was selected as the second because he wishes to get back to the university for football practice.

MAJOR W. C. CAMPBELL, a British army officer, was killed and THEODORE DE KRAFFT, a Harvard University student, were seriously injured by the fall of an aeroplane at the Curtiss Aviation School on September 8. The machine fell about 500 feet.

LIEUT. W. W. SPAIN has gone to Chicago where he will assist Captain J. C. Morrow in the operation of the Army Aviation School at Ashburn.

LIEUT. J. C. BELLINGER, of the army aviation corps, has made a series of tests at Atlantic City bearing upon the practical use of flying machines for coast guard patrol duty. He is using a high-powered monoplane. This city has been designated by the War Department as the base from which the experiments will extend along the Atlantic coast.

WILLIAM EART DODGE, yachtsman and amateur aviator, accompanied by his instructor, FREDERICK EDEN, flew on August 31 in a Curtiss flying boat from Newport, R. I., over Long Island Sound, to Port Washington, in two hours and forty-five minutes. Soon after they started they were out of sight of the throng on the Newport shore that saw them leave. He made an average speed of forty-seven miles an hour and traveled under ideal conditions with the motor working smoothly along the entire journey of 130 miles. Mr. Dodge and his instructor made a perfect landing on the floating hangar of the American Transoceanic Company in Manhasset Bay. He intends to devote considerable time to aviation and has just placed an order for two new Curtiss tractors.

CAPTAIN RALPH MCMILLAN, head of the Aviation Corps of Nebraska National Guard, was killed in a flight at St. Francis, Kans., on September 2.

E. L. RUSSELL plans to establish an aviation school and aeroplane factory at Great Falls, Mont.

THE WILLIAMS PRINTING COMPANY NEW YORK